Clean Coal Technology Demonstration Program
Advanced Electric Power Generation
Integrated Gasification Combined-Cycle

Kentucky Pioneer Energy IGCC Demonstration Project

Participant

Kentucky Pioneer Energy, LLC

Additional Team Members

Fuel Cell Energy, Inc. (formerly Energy Research Corporation)—molten carbonate fuel cell designer and supplier, and cofunder

Location

Trapp, Clark County, KY (East Kentucky Power Cooperative's Smith site)

Technology

Integrated gasification combined-cycle (IGCC) using a BG/L (formerly British Gas/Lurgi) slagging fixed-bed gasification system coupled with Fuel Cell Energy's molten carbonate fuel cell (MCFC)

Plant Capacity/Production

580 MWe (gross); 540 MWe (net) IGCC; 2.0 MWe MCFC

Coal

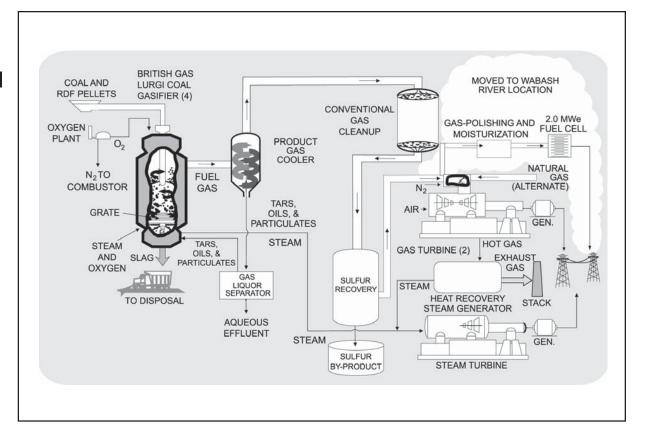
High-sulfur Kentucky bituminous coal and pelletized refuse-derived fuel (RDF)

Project Funding

Total	\$431,932,714	100%
DOE	78,086,357	18
Participant	353,846,225	82

Project Objective

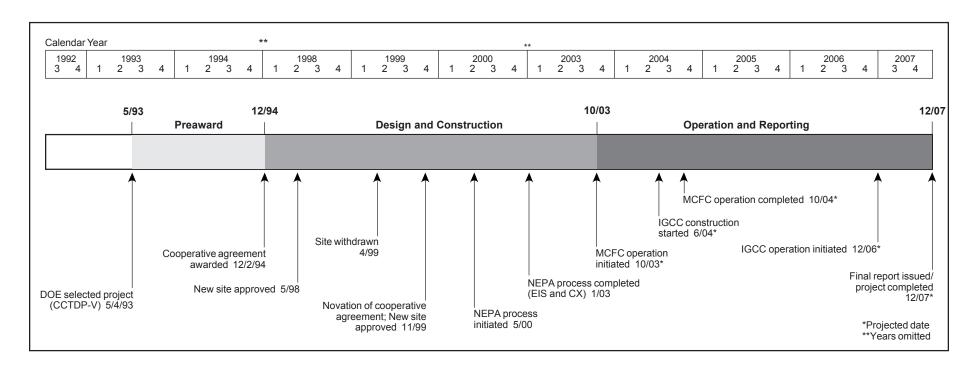
To demonstrate and assess the reliability, availability, and maintainability of a utility-scale IGCC system using a high-sulfur bituminous coal and refuse-derived fuel (RDF) blend in an oxygen-blown, fixed-bed, slagging gasifier and the operability of a molten carbonate fuel cell fueled by coal gas.



Technology/Project Description

The four BG/L gasifiers are supplied with steam, oxygen. limestone flux, and a coal and pelletized RDF. During gasification, the oxygen and steam react with the coal and limestone flux to produce a coal-derived fuel gas rich in hydrogen and carbon monoxide. Raw fuel gas exiting the gasifier is washed and cooled. Hydrogen sulfide and other sulfur compounds are removed. Elemental sulfur is reclaimed and sold as a by-product. Tars, oils, and dust are recycled to the gasifier. Instead of ash, the inorganic components in the feedstock are reduced to a non-leaching silica matrix that will be used as a synthetic aggregate. The resulting clean, medium-Btu fuel gas fires two gas turbines. Operation will commence on 100% coal with slowly increasing levels of RDF throughout the demonstration. This method will allow the development of a database of plant performance at various levels of RDF feed.

The MCFC, which has been relocated to another site, is composed of a molten carbonate electrolyte sandwiched between porous anode and cathode plates. Fuel (desulfurized, heated medium-Btu fuel gas) and steam are fed continuously into the anode; CO₂-enriched air is fed into the cathode. Chemical reactions produce direct electric current, which is converted to alternating current with an inverter.



Project Status/Accomplishments

On May 8, 1998, DOE conditionally approved Ameren Services Company (merger of Union Electric Co. and Central Illinois Public Service Co.) as an equity partner and host site provider subject to completing specific business and teaming milestones. The new project site to be provided by Ameren was at its Venice Station Plant in Venice, Illinois. On April 30, 1999, Ameren Services Company withdrew from the project for economic and business reasons.

In May 1999, Global Energy USA Limited (Global), sole owner of Kentucky Pioneer Energy, LLC (KPE), expressed interest in acquiring the project and providing a host site at East Kentucky Power Cooperative's Smith Site in Clark County, Kentucky. Subsequently, Global negotiated all the necessary documents with DOE and Clean Energy Partners, L.P. (CEP) to acquire the project. In November 1999, the cooperative agreement was novated and the new site was approved.

The NEPA process for the IGCC plant was completed with the Record of Decision being issued on January 29, 2003. The NEPA process for the fuel cell was completed with the issue of a categorical exclusion on September 30, 2002. The heat rate of the IGCC demonstration facility is projected to be 8,560 Btu/kWh (40% efficiency) and the commercial embodiment of the system has a projected heat rate of 8,035 Btu/kWh (42.5% efficiency). These efficiencies represent a greater than 20% reduction in emissions of $\rm CO_2$ when compared with a conventional pulverized coal plant equipped with a scrubber. The $\rm SO_2$ emissions from the IGCC system are expected to be less than 0.1 lb/106 Btu (99% reduction); and $\rm NO_x$ emissions less than 0.15 lb/106 Btu (90% reduction).

The fuel cell portion of the project has been relocated to Global Energy's Wabash site and was dedicated in August 2003. The fuel cell will be operated on coal-derived syngas. The move will advance the MCFC demonstration by two years.

Commercial Applications

The IGCC system being demonstrated in this project is suitable for both repowering applications and new power plants. The technology is expected to be adaptable to a wide variety of potential market applications because of several factors. First, the BG/L gasification technology has successfully used a wide variety of U.S. coals. Also,

the highly modular approach to system design makes the BG/L-based IGCC and MCFC competitive in a wide range of plant sizes. In addition, the high efficiency and excellent environmental performance of the system are competitive with or superior to other fossil-fuel-fired power generation technologies.